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Bauji Shallot Variety (*Allium ascalonicum* L.) Growth Respond And Yield After *Kirinyuh* Plant Methanol Extract (*Chromolaena odorata* L.) Treatment

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ABSTRACT

It is crucial to improve the shallot (*Allium ascalonicum* L.) cultivation system on peatlands to increase the growth and production of shallots. One is the provision of Biostimulants derived from Kirinyuh (*Chromolaena odorata* L.) extract. This study aimed to determine the effect of Kirinyuh (C. odorata) methanol extract on the growth and yield of shallot (A. ascalonicum) and to determine the best concentration and application time of Kirinyuh extract to increase the growth and yield of shallots. This research was conducted from September to December 2020 at the Biology Laboratory and Greenhouse Department of Biology, Faculty of Mathematics and Natural Sciences, Tanjungpura University, Pontianak. The study used a completely randomized (CRD) factorial pattern with two factors. The first factor was the concentration of Kirinyuh extract, which consisted of 5 treatments (0; 25; 50; 75, and 100 mg/L), and the second factor was application time which consisted of 2 treatments (1 week and two weeks). The results showed that the combination of Kirinyuh extract concentration and application time had a significant effect on wet shoot weight, dry shoot weight, tuber quantity, wet tuber weight, and tuber dry weight but had no significant effect on plant height, number of leaves, wet weight of roots, dry weight, root and tuber diameter. The concentration of Kirinyuh extract and the best application time was 100 mg/L with an application time of 2 weeks.

Keywords: *Allium ascalonicum, Chromolaena odorata, biostimulant, growth, productivity.*

1. INTRODUCTION

Shallot (*Allium ascalonicum*) is a horticultural plant with many benefits, e.g., as a flavoring agent, traditional medicine, and industrial raw material. (Wisudawati & Lapanjang, 2016). The shallots cultivation in West Kalimantan has not yet developed, so to supply shallots demand; they are still imported from outside Kalimantan (Pengkajian *et al*., 2019). The low production of shallots in peat soils is caused by the nature of the peat soil, which affects the growth and production of shallots. Most peat soils have a low pH (< 5.12) and low nutrients available to plants (Sabiham, 2010; Dramaga, 2012).

One of the efforts that can be made to increase plant growth and production is by adding Biostimulants. It is bioactive compounds derived from plants or microorganisms that can be applied to plants to maximize the absorption of nutrients such as N, P, K, Cu, and other micronutrients, tolerance of abiotic stresses, and improve plant quality as well as contribute to the efficiency of fertilizer use. (Calvo *et al*., 2014). A study by (Pengkajian *et al*., 2019) showed that seaweed extract significantly affected leaf length, leaf quantity, tuber weight, and the number of shallot tillers. The research results by (Rajiman, 2019) showed that the aqueous extract of Moringa leaves with higher concentrations increased the number of shallot leaves.

Kirinyuh plant is a plant that contains secondary metabolites in the form of alkaloids, flavonoids, steroids, terpenoids, and saponins (Munte *et al*., 2016) containing nutrients (N, P, K, Ca, Mg) (Koutika & Rainey, 2010) and amino acids (Ngozi *et al*., 2009) The *Kirinyuh* extract treatment on mustard greens had a significant effect on germination time (Damayanti, 2012). Research using *Kirinyuh* extract on horticultural plants such as soybeans, beans, and radishes significantly affected plant height, fresh weight, root length, and pods quantity (Damayanti, 2012). So far, *Kirinyuh* has only been used as a bioherbicide, but because of its secondary metabolite content, mainly when applied in low concentrations, it has the potential as a biostimulant.

2. MATERIAL AND METHOD

This research was carried out for four months, from September to December 2020. in the Laboratory and screen house of the Department of Biology, Faculty of Mathematics and Natural Sciences, Tanjungpura University, Pontianak.

The materials used were distilled water, ethanol, dolomite lime, cow manure, urea fertilizer, SP36 fertilizer, KCl fertilizer, onion tubers (Allium ascalonicum), Bauji variety, *Kirinyuh* plant (Chromolaena odorata), technical methanol and peat soil. The tools used in this study were a blender, beaker, measuring cup, hygrometer, camera, gauze, oven, ruler, dropper, 20 x 40 cm polybag, analytical scale, glass jar, and Vacuum Rotary Evaporator.

The study used a factorial, completely randomized design (CRD) with two treatment factors. The first factor is the concentration of C. odorata extract which consists of 5 concentration levels 0 mg/l (control) (K0), 25 mg/l (K1), 50 mg/l (K2), 75 mg/l (K3) and 100 mg/l (K4). The second factor is that the application time consists of 2 levels every week and every two weeks. Each treatment consisted of 5 replications. Growth parameters and yields observed were plant height, leaves quantity, canopy wet weight, shoot dry weight, root wet weight, root dry weight, number of tubers, tuber diameter, wet tuber weight, and tuber dry weight. Data analysis with two-way ANOVA (Analysis of Variance) test, if the ANOVA test results have a significant effect, then continue with the DMRT (Duncan's Multiple Range Test) tests at a 5% confidence level.

The stages in this research can be seen in the following flow diagram:

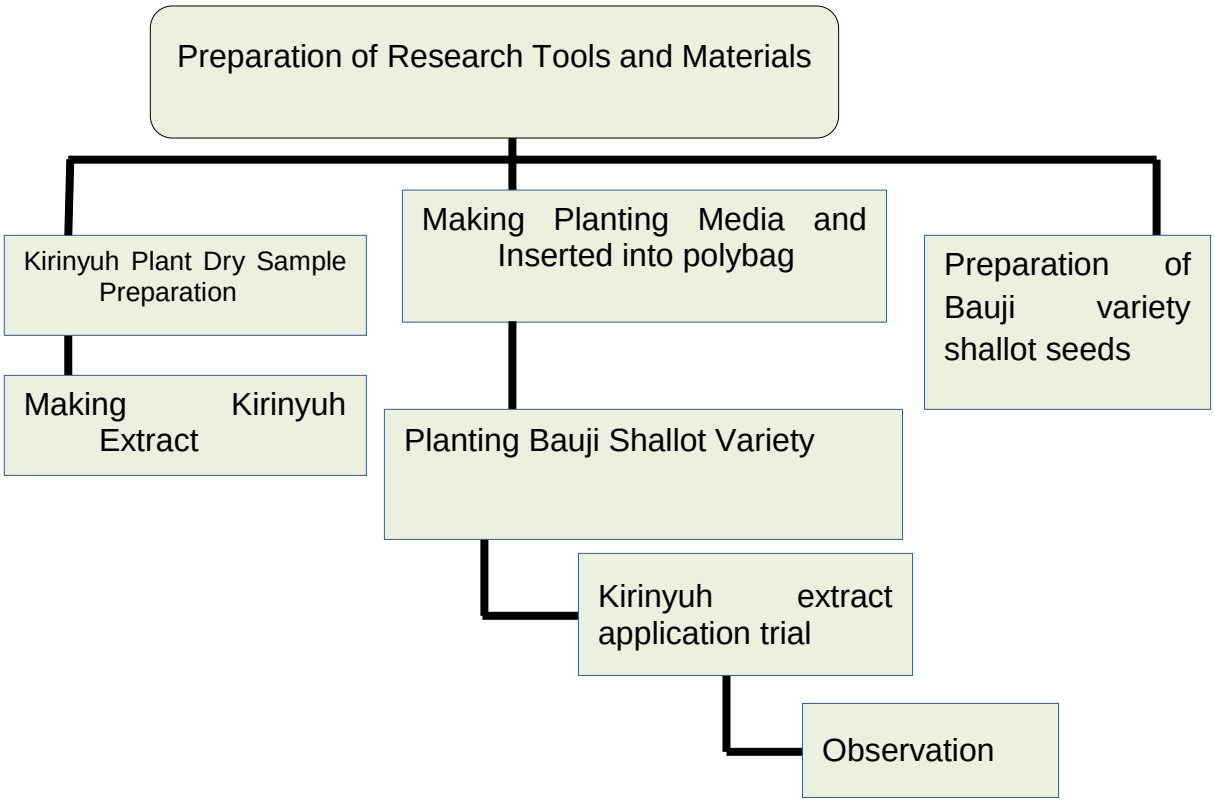

Figure 1. Research Flowchart

3. RESULT AND DISCUSSION

A. Plant Height (Cm)

The results of the ANOVA analysis on the growth response and yield of shallot (Allium ascalonicum L.) Bauji variety after administration of *Kirinyuh* methanol extract (Chromolaena odorata L.) can be seen in Table 1.

Table 1. ANOVA analysis results of growth response and yield of shallot (Allium ascalonicum L.) Bauji variety after administration of *Kirinyuh* methanol extract (Chromolaena odorata L.)

No	Parameter	F-hit	KK (%)
1	Plant Height (cm)	0.42^{tn}	8.42%
2	Leaf Quantity (ea)	0.894^{tn}	9.51%
3	Shoot Wet Weight (g)	5.39**	11.52%
4	Root Wet Weight (g)	0.16 ^{tn}	30.22%
5	Shoot Dry Weight (g)	3.35*	17.66%
6	Root Dry Weight (g)	0.64 ^{tn}	37.78%
7	Tubers Quantity (ea)	6.83**	27.16%
8	Tuber Diameter (cm)	1.96^{tn}	60.12%
9	Tuber Wet Weight (g)	4.92*	54.84%
10	Tuber Dry Wet (g)	8.28**	30.45%

Note : * = Significant ** = Very Significant
tn = Not Significant KK = Coefficient Of Diversity

Based on the results of the ANOVA analysis in Table 1. it shows that the administration of *Kirinyuh* extract on the growth and yield of shallots showed very significant results on the parameters of the wet weight of the crown, tubers quantity, and the dry weight of the tubers and significant results on the parameters of the dry weight of the crown and the wet weight of the tubers. This is assumed to be due to various bioactive compounds such as alkaloids, flavonoids, terpenoids, steroids, and saponins contained in *Kirinyuh* extract, which can trigger plant growth and development. *Kirinyuh* contains a secondary metabolite substance (Munte *et al*., 2016) and amino acid (Ngozi *et al.*, 2009). Pengkajian *et al*. (2019) state that biostimulants derived from seaweed extracts contain amino acids, cytokinins, auxins, laminarin, fucoidan, alginate, and betaine which stimulate plant metabolism to increase plant growth and yield.

Biostimulants from plant extracts can reduce the consumption of chemical fertilizers by increasing the absorption of macro and micronutrients by plants. Biostimulants from plant extracts can also increase hormone formation by influencing plants' biochemical and physiological processes, such as glycolysis and nitrogen assimilation. (Ertani *et al*., 2015). (Mvumi *et al.*, 2013) Moringa leaf extract (Moringa oleifera) contains natural cytokinin hormones such as zeatin, dihydrozeatin, and isopentyladenine, proteins, minerals, vitamins, amino acids, glucosinolates, isothiocyanates and phenolics that can trigger plant growth. Based on (Mona, 2013), Moringa oleifera plant extract as a Biostimulant in the Eruca vesicaria plant can increase the production of the hormones auxin gibberellins and cytokinin.

The hormone auxin affects the synthesis of structural proteins to perfect the structure of the cell wall back to normal after undergoing stretching or stretching, gibberellins stimulate plant height growth, and cytokinins play a role in the process of cell division. The hormones auxin, cytokinin, and gibberellins play a role in supporting the increase in plant height, and the biosynthetic reactions of hormones and proteins can take place quickly (Gbadegesin & Akagbuo, 2013).

According to (Daayf, 2014), The content of secondary metabolites such as flavonoids can affect plant growth. Several flavonoids such as quercetin, apigenin, and kaempferol can stimulate plant growth by binding to the IAA (indole acetic acid) transport inhibitor receptor, e.g., Naphthylthalamic acid (NPA). This causes the transport of IAA across the membrane to run well so that it can increase plant height. (Geisler, 2021) flavonoid compounds can regulate auxin transport on the plasma membrane, and flavonoid compounds can replace NPA, which binds to carrier proteins and does not cause the opposite effect so that auxin transport can run well.

Duncan's further test results on the growth response and yield of shallot (Allium ascalonicum L.) Bauji variety after administration of *Kirinyuh* methanol extract (Chromolaena odorata L.) can be seen in Table 2.

Table 2. Duncan's advanced test results, growth response, and yield of shallot (*Allium ascalonicum* L.) Bauji variety after administration of *Kirinyuh* methanol extract (*Chromolaena odorata* L.)

Extract Concentration	Application Time		Average
	Once a Week	Every Two Weeks	
	Plant Height (cm)		
0 mg/L	31.82	28.62	30.32[a]
25 mg/L	36.74	35.80	36.27[b]
50 mg/L	38.32	33.00	35.66[b]
75 mg/L	37.06	32.28	34.69[b]
100 mg/L	37.46	32.16	34.81[b]
Average	36.28[a]	32.45[a]	
	Leaf Quantity (ea)		
0 mg/L	22.40	21.60	22.00[a]
25 mg/L	27.00	23.80	25.40[b]
50 mg/L	27.60	26.20	26.90[b]
75 mg/L	25.80	25.00	25.40[b]
100 mg/L	26.40	27.20	26.80[b]
Average	25.84[a]	24.76[a]	
	Shoot Wet Weight (gram)		
0 mg/L	9.86[a]	9.20[a]	9.53[a]
25 mg/L	9.98[ab]	10.40[b]	10.19[b]
50 mg/L	11.40[bc]	12.13[bc]	11.76[b]
75 mg/L	10.28[b]	11.75[bc]	11.01[b]
100 mg/L	9.0[a]	13.16[c]	11.08[b]
Average	10.10[a]	11.32[a]	
	Root Wet Weight (gram)		
0 mg/L	0.50	0.56	0.53[a]
25 mg/L	0.64	0.62	0.63[a]
50 mg/L	0.60	0.72	0.66[a]
75 mg/L	0.62	0.60	0.61[a]
100 mg/L	0.58	0.66	0.62[a]
Average	0.58[a]	0.63[a]	
	Shoot Dry Weight (gram)		
0 mg/L	4.10[ab]	3.9[a]	4.03[a]
25 mg/L	4.24[ab]	4.98[bc]	4.61[b]
50 mg/L	5.44[bc]	6.00[bc]	5.72[b]
75 mg/L	4.40[b]	5.88[bc]	5.14[b]
100 mg/L	3.88[a]	6.38[c]	5.13[b]
Average	4.41[a]	5.44[b]	
	Root Dry Weight (gram)		
0 mg/L	0.25	0.37	0.31[a]
25 mg/L	0.44	0.42	0.43[a]
50 mg/L	0.46	0.51	0.48[a]
75 mg/L	0.47	0.38	0.43[a]
100 mg/L	0.39	0.43	0.41[a]
Average	0.41[a]	0.42[a]	
	Tuber Quantity (ea)		

0 mg/L	4.40[b]	4.80[b]	4.70[a]
25 mg/L	5.00[bc]	4.60[b]	4.80[a]
50 mg/L	5.20[bc]	6.40[de]	5.80[a]
75 mg/L	6.00[bcd]	4.20[ab]	5.10[a]
100 mg/L	3.20[a]	7.60[e]	0.62[a]
Average	4.76[a]	5.52[a]	
	Tuber Diameter (cm)		
0 mg/L	1.54	1.00	1.18[a]
25 mg/L	1.38	1.36	1.40[a]
50 mg/L	1.58	1.42	1.44[a]
75 mg/L	1.40	1.46	1.40[a]
100 mg/L	1.52	1.50	1.54[a]
Average	1.42[a]	1.34[a]	
	Tuber Wet Weight (gram)		
0 mg/L	7.62[a]	6.20[a]	6.91[a]
25 mg/L	8.64[ab]	10.40[bc]	9.52[b]
50 mg/L	9.30[ab]	12.94[bc]	11.12[b]
75 mg/L	10.24[bc]	10.44[bc]	10.34[b]
100 mg/L	6.18[a]	14.46[c]	10.32[b]
Average	8.39[a]	10.88[a]	
	Tuber Dry Weight (gram)		
0 mg/L	2.28[b]	0.64[a]	2.92[a]
25 mg/L	1.62[b]	4.70[d]	3.16[b]
50 mg/L	1.80[b]	4.52[d]	3.16[b]
75 mg/L	3.66[c]	5.66[e]	4.66[b]
100 mg/L	3.72[c]	6.26[e]	4.99[b]
Average	2.61[a]	4.34[b]	

Note: The numbers in the column followed by the same letter are not significantly different based on Duncan's test at the 5% level.

The results of Duncan's further test at a 5% confidence level were marked by a significant response to the parameters of wet canopy weight, dry canopy weight, number of tubers, wet tuber weight, and tuber dry weight. The best results were on the parameters of the wet canopy weight, dry canopy weight, number of tubers, wet tuber weight, and tuber dry weight.

The application treatment of *Kirinyuh* extract concentration, which gave a significant response to the canopy's average wet weight and dry weight, could be related to many leaves formed. The more leaves formed, the wet weight and dry weight of the canopy increased, and conversely, the fewer leaves formed, the lower the wet weight and dry weight of the canopy were. The content of secondary metabolites contained in the extract also affects the average wet weight and dry weight of the crown. According to (Ebenezer *et al*., 2019), Some secondary metabolites, especially terpenoids, can act as bioregulators of plant growth.

(M. Pahor, Manini, 2008) stated that gibberellins are part of terpenoid compounds belonging to the diterpenoid class; terpenoid compounds have bioactivity to stimulate growth and encourage gibberellins activity in plant tissues so that they can increase plant growth. A Study by (Aulya*,* 2017) showed that mangosteen rind extract containing terpenoid compounds had a significant effect on the wet weight and dry weight of the corn plant canopy, with the best results at a concentration of 100 mg/L extracts.

The results showed that the application of *Kirinyuh* extracts once every two weeks significantly responded to the wet canopy weight, canopy dry weight, number of tubers, wet tuber

weight, and tuber dry weight. This is presumably because Biostimulants can penetrate well into plant tissues within a 2-week application period to increase plant growth and production. This study results parallel to (Mvumi *et al*., 2013), using Moringa (Moringa oleifera) extract on the growth and yield of tomato plants, showed that the application of Moringa extract every two weeks increased the dry weight of yield, root dry weight, and tomato plant height, in cabbage and radish plants it could increase root growth, plant height, number of leaves and crop yields. Research results by (Mvumi *et al*., 2013) showed that Moringa extract application (M. oleifera) every two weeks is also the best treatment that can increase plant height, dry weight, and yield of chickpea (Phaseolus vulgaris).

The formation of the number of tubers can be related to a large number of scallions formed. The more leaves formed, the more tubers formed; conversely, the fewer leaves formed, the fewer tubers formed (Pakpahan *et al*., 2020). The concentration treatment of *Kirinyuh* extract of 100 mg/L resulted in an average number of leaves as many as 26.80. According to (Ramadhan & Maghfoer 2018), the number of leaves will affect photosynthesis, and the resulting photosynthate will be used and allocated for tuber formation and storage of food reserves.

The results showed that the combination treatment of *Kirinyuh* extract concentration and application time was insignificant to the average wet weight of roots, dry weight of roots, and diameter of shallot tubers. The concentration treatment of *Kirinyuh* extract in this study had no significant effect on several parameters, presumably due to the antagonistic effect of the content of secondary metabolites that inhibit growth. Based on *(*Aulya, 2017) the content of secondary metabolites in various extracts, the role of secondary metabolites in plants depends on the synergistic or antagonistic effect of these compounds with the test plant, so the response given can be different in plants.

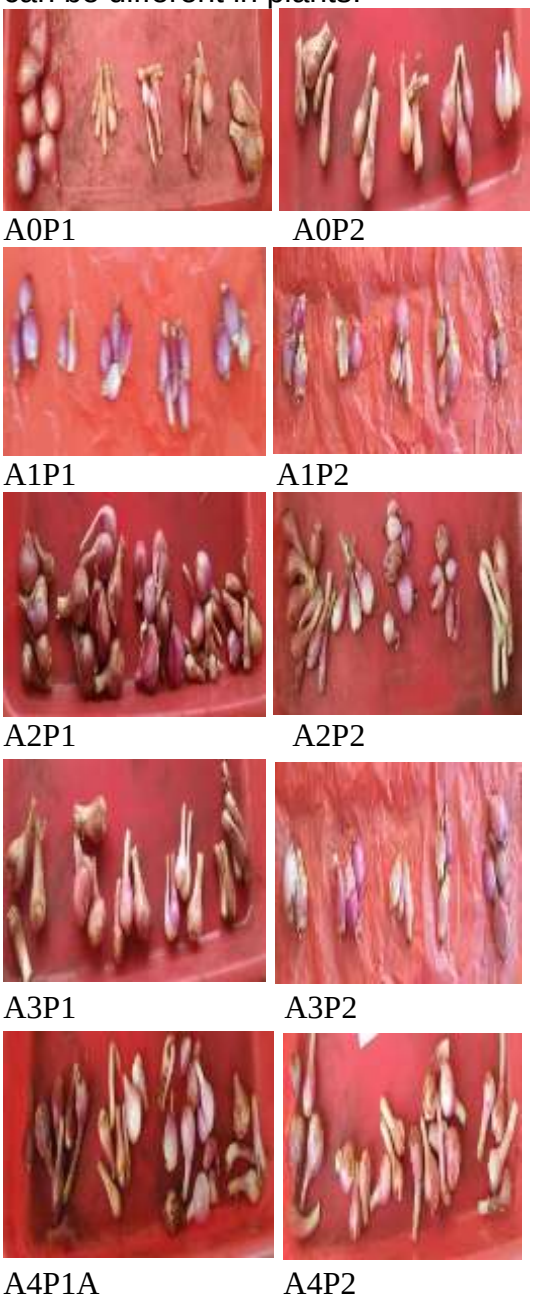

Figure 2. Comparison of shallot yields between treatments

Information:

A0 = Control ; P1 = Once a Week
A1 = 25 mg/L ; P2 = Every Two Weeks
A2 = 50 mg/L
A3 = 75 mg/L
A4 = 100 mg/L

Secondary metabolites which are thought to inhibit plant growth are phenolic compounds. Not all phenol compounds are inhibitory, depending on their concentration in the extract. Phenol compounds can play an increasing role if the concentration is small and inhibit if the concentration is high. The phenolic compounds in Kirinyuh extract are thought to reduce enzyme activity and membrane permeability. According to (Devkota & Sharma, 2015), Phenol compounds can interfere with the division of root cells, reduce membrane permeability, decrease enzyme activity, and cause damage to the hormones IAA and gibberellins. It has an impact on disrupting plant growth and development. A study by (Jane, 2016) showed that *Kirinyuh* extract with a concentration ratio of 1g/140 ml of water, one g/80 ml of water, and one g/40 ml of water had no significant effect on the wet weight of tomato roots.

4. CONCLUSION

Based on the results of the study, it could be concluded that the administration of *Kirinyuh* extract had a significant effect on plant growth parameters, i.e., plant height, leaves quantity, wet canopy weight, and canopy dry weight, but did not significantly affect wet root weight and root dry weight. The administration of *Kirinyuh* extract also significantly affected the production of shallots, e.g., tubers quantity, wet weight of tubers, and dry weight of tubers but had no significant effect on tuber diameter. The concentration of *Kirinyuh* extract 100 mg/L with an application time of 2 weeks gave the best results for the parameters of the average wet weight of the crown (13.46 g), the dry weight of the crown (6.38 g), tubers quantity (7.60 cloves), the wet tuber (14.46 g) and tuber dry weight (6.26 g).

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